(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 747 638 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.12.1996 Bulletin 1996/50

(51) Int. Cl.[6]: **F24C 7/02**, F24C 15/32

(21) Application number: **96107963.9**

(22) Date of filing: **20.05.1996**

(84) Designated Contracting States:
DE FR GB

(30) Priority: **09.06.1995 KR 9512978 U**
28.07.1995 KR 9522902
07.10.1995 KR 9534455

(71) Applicant: **Samsung Electronics Co., Ltd.**
Suwon-City, Kyungki-do 441-742 (KR)

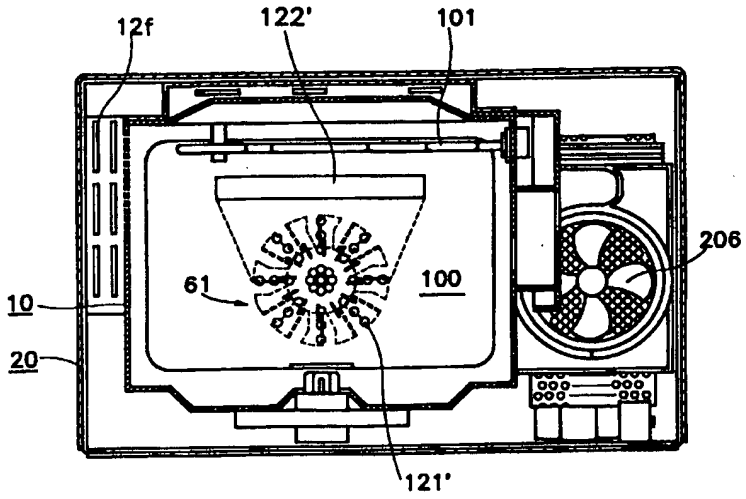
(72) Inventor: **Hong, Seok Weon**
Suwon-City, Kyungki-Do (KR)

(74) Representative: **Neill, Alastair William et al**
APPLEYARD LEES
15 Clare Road
Halifax, West Yorkshire HX1 2HY (GB)

(54) Convection microwave oven

(57) The convection microwave oven is comprised of an inner case 10 defined as a cooking chamber 100 and an outer case 20 assembled with the inner case while exposing a rear plate 12 of the inner case. A duct 50 is mounted on the rear plate of the inner case. At the interior of the duct a blowing fan 61 is provided and at the exterior of the duct a cooling fan 71 is provided covering with a shield 80 which acts as a cover. A plurality of inlets 121 and outlets 122 are formed at the rear plate 12. A heater 101 is installed in the cooking chamber. A guiding channel 55 formed in the duct 50 is comprised of a semi-circular intake guide portion 55a, a widening portion 55b and a blow-out portion 55c.

FIG. 7



EP 0 747 638 A1

Description

BACKGROUND OF THE INVENTION

The invention is related to a microwave oven having the convection cooking function of hot air in addition to its inherent microwave function.

A microwave oven is a cooking apparatus utilizing the principle that foodstuff in a chamber is caused to release heat by its own molecular motion, by applying microwaves having almost 2,450 MHz in frequency. In a microwave oven, microwaves are radiated from a magnetron and guided into the chamber. Foodstuffs comprised of molecular particles are charged both positively and negatively, respectively, by the guided microwaves. At the positive pole of the electrical field one end of the molecule is charged negative, whilst at the negative pole of the electrical field the other end of the molecule is charged positive. Since dipoles of electrical field are changeable by microwaves at 2,450 million per second, molecules of foodstuff are collided with each other, generating heat of collision so as to cook the foodstuff.

In a recent microwave oven, the cooking function using radiation heat of a heater in addition to using the microwave function has been added. The grill microwave oven, as shown in Figure 9, has an electrical heater 92 in the cooking chamber 91. Further, a magnetron 94 is installed in an electrical chamber 93 partitioned from the cooking chamber 91. Thus cooking utilizing a microwave generated from the magnetron can be used as well as utilizing the electrical heater 92. 95 designates a thermal resistance material for preventing the transfer of heat of the heater to the environment.

However, the grill microwave oven has a problem that foodstuff can not be cooked effectively since radiation heat of the electrical heater is unevenly applied to foodstuff placed on the bottom of the cooking chamber. That is, radiation heat emitted from the heater reaches only the upper portion of the foodstuff, resulting in not fully cooked foodstuff.

Further, a microwave oven adding the convection heat cooking function in addition to microwave cooking function is disclosed in Japanese Patent Laid-Open 1993 (JP 5) - 312326 as shown in Figure 10. The convection microwave oven is comprised of an inner case 301a served as a cooking chamber 301 and an outer case 306 housing the inner case 301a. Various kinds of electrical components are mounted between the inner case 301a and the outer case 306. Further, a duct 307a serving as a hot air chamber 307 is attached to a rear plate 304a of the cooking chamber 301. A blowing fan 308 is provided in the hot air chamber 307. A plurality of openings 301b are formed in the rear plate 304a, through which air exchanges between the cooking chamber 301 and the hot air chamber 307. An electrical heater 302 is mounted in the hot air chamber 307. To prevent the transfer of the heat emitted from the heater toward the rear area, thick thermal resistance material 307b is attached to the inner side of the duct 307a. A cooling fan is installed coaxially to the blowing fan 308, and a motor 308b is mounted for driving both fans 307a, 308a. The duct 307a, cooling fan 308a and motor 308b are covered by a rear plate 306a of the outer case 306.

In the convection microwave oven, convection heat cooking is performed by the heater 302 and the blowing fan 308. The heat generated from the heater 302 is forcedly circulated in the hot air chamber 307 and the cooking chamber 301. During the circulation, the heat is transferred to foodstuff in the cooking chamber 301, making cooking possible. Simultaneously, the cooling fan 308a is rotated and the motor 308b is cooled by the outside air.

However, since the heater, the duct having the thick heat resistance material, the blowing fan, the cooling fan and the motor are mounted between the rear plate of the inner case and the rear plate of the outer case, a larger space between the rear plates is required. That causes the problem of the increase of the whole volume.

Further, when components of the installation plate are out of order, the rear plate must be detached in order to replace the components, causing much complication.

Furthermore, an inlet and outlet formed on the rear plate are arranged close to each other, which disturbs the airstream. This causes a decrease of effective air volume in the cooking chamber and uneven distribution of the hot air in the cooking chamber, resulting in an ineffectiveness problem.

Next, a duct is provided at an ineffective plate and the airstream can not be guided effectively, thus having difficulty in making even and fast cooking.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a convection microwave oven for enabling the airstream to be fed effectively and increasing the effective volume of the air, thus allowing more even cooking.

Another object of the present invention is to provide a convection microwave oven suitable for quicker and faster cooking by developing a faster airstream.

Another object of the present invention is to provide a convection microwave oven for preventing turbulence of the hot air by improving the configuration arrangement of both the outlet and inlet, resulting in a more active airstream and the increase of cooking efficiency.

Another object of the present invention is to provide a convection microwave oven that achieves compactness and simplicity, although the oven is equipped with a grill and a heat convection cooking function in addition to a microwave cooking function.

According to one aspect of the present invention a convection microwave oven is comprised comprising a body, a cooking chamber housed in the body, a fan rotatably mounted between the body and the cooling chamber for circulating the air in the cooking chamber, an inlet provided on a wall of the cooking chamber for

drawing the air in the cooking chamber into the fan, an outlet provided on a wall of the cooking chamber for blowing the air via the fan toward a heater arranged in the cooking chamber.

Preferably, the fan is disposed adjacent to the inlet.

Preferably, the inlet is disposed on a lower or an upper portion of the wall of the cooking chamber and the outlet is disposed on an upper or a lower portion of the wall of the cooking chamber.

Preferably, a duct is further comprised, the fan is housed in the duct and one of the ducts is directed to the inlet and another thereof is directed to the outlet.

By way of example, specific embodiments of the invention will now be described, with reference to the accompanying drawings, in which :-

Figure 1 is a perspective exploded view of a first embodiment of convection microwave oven according to the present invention;

Figure 2 is a partial broken perspective view of the first embodiment of convection microwave oven according to the present invention;

Figure 3 is a sectional view taken along the line 3-3 of Figure 2;

Figure 4 is a sectional view taken along the line 4-4 of Figure 1;

Figure 5 is a perspective exploded view of a duct and a convection means according to the first embodiment of the present invention;

Figure 6 is an alternative view of Figure 4, having another embodiment of an inlet and an outlet;

Figure 7 is an alternative view of Figure 4, having another embodiment of an inlet and an outlet;

Figure 8 is an alternative view of Figure 4, having another embodiment of guiding groove of a duct;

Figure 9 is a front sectional view of a convection microwave oven according to the prior art; and

Figure 10 is a side sectional view of a convection microwave oven according to the prior art.

In Figure 1, a convection microwave oven is comprised of an inner case 10, an outer case 20 and various electrical components placed between the inner case 10 and the outer case 20. At the rear of case assembly 10, 20 a duct assembly 50 and a shield 80 are detachably mounted. The inner case 10 is comprised of a front plate 11, a rear plate 12, a left plate 13, a right plate 14, a top plate 15 and a bottom plate4 16, thereby defining a cooking chamber 100. The front plate 11 has an opening utilized as an inlet of the cooking chamber 100. The front plate 11 is extended in length and width directions with a predetermined length, having a widened upper, left and right plate 11a, 11c and 11d. The rear plate 12, facing the front plate 11, is comprised of a widened upper, left and right plate 12a, 12c and 12d which are extended in length and width directions.

The outer case 20 is comprised of a top plate 21, a bottom plate 22, a left plate 23 and a right plate 24. Each edge of plates of the outer case 20 borders the corresponding edge of the widened plates 11a, 11c, 11d, 12a, 12c, 12d of the front and rear plates 11, 12, thereby forming the body of the microwave oven. The traverse or frontward length of each plate of the outer case 20 is the same as that of each plate of the inner case 10. The longitudinal or sideways length of the top plate 21 is the same as that of the front or rear plate 11, 12. Since the rear plate 12 of the inner case 10 serves as the rear plate of the outer case 20, an additional rear plate of the outer case is no longer needed.

A door 30 is hinged at the front plate 11 of the inner case 10 to close or open the opening of the cooking chamber 100. At the right widened plate 11d a control box 40 having a display portion 41 and a button 42 is place at a level even with the door 30. The space, defined by the right plate 14 of the inner case 11, the right plate 24 of the outer case 20, the widened right plate 11d of the front plate 11 and the widened right plate 12d of the rear plate 12, forms an electrical component chamber 200.

To cool the air in the electrical component chamber 200 and get rid of humidity and odor in the cooking chamber 100, a plurality of inlets 12e, 14a are provided at the right widened plate 12d and the right plate 14, respectively. Further, a plurality of outlets 13a, 12f are provided at the left plate 13 and the left widened plate 12c, respectively. With the operation of the cooling fan which will be described later, the outside air is drawn into the electrical component chamber 200 and the cooking chamber 100 through the inlets 12e, 14a and is blown out through the outlets 13a, 12f.

The electrical component chamber 200, as shown in Figure 2, has a magnetron 201 as a microwave emitting means. A high voltage transformer 202 for supplying the high voltage to the magnetron 201, a high voltage diode 203, a high voltage capacitor 204 and a choke circuit board 205 serving as a control unit are provided in the electrical components chamber 200. To cool off the heat generated by the operation of the electrical components, a cooling fan 206 is mounted on the inside surface of the right widened plate 12d.

In Figure 3, a heater 101, which is caused to emit heat by electricity supplied from the high voltage transformer 202, is rotatably provided in the cooking chamber 100. A duct 50 is mounted at the rear plate 12 having openings 121, 122. The openings 121, 122 are used as the inlet and outlet for the forced circulation air. And by using the openings 121, 122, the cooking chamber 100 is intercommunicated with the duct 50. A circulating means 60 and a cooling means 70 are installed in

the duct 50. The circulating means 60 is comprised of a circulating fan 61 provided in the duct 50, a rotating shaft 62 mounted through the duct 50 and having the fan at one end thereof and a motor 63 installed at the other end thereof. The cooling means 70 is comprised of a cooling fan 71 mounted at the shaft 62 between the duct 50 and the motor 63.

The inlet 121 is formed at the lower portion of the rear plate 12, whilst the outlet 122 is formed at the upper portion of the rear plate 12 as shown in Figure 4. The inlet 121 or the outlet 122 has a plurality of the small size openings for preventing the microwaves from passing through the inlet 121 or outlet 122. The inlet 121 is spaced from the outlet 122 at a predetermined distance. The flow of the air through from the outlet 122 can not be mixed with the flow of the air through toward the inlet 121. The circulating fan 61 is placed facing the inlet 121. An outline of the inlet 121 is a V or U configuration to make a corresponding shape with the duct 50. Therefore, the air passing through the inlet 121 guides towards the outlet 122 more effectively. It is desirable that the outer 122 is shaped with the same as the longitudinal length of the heater 101 so as to diffuse the air toward the cooking chamber 100 in a proper manner.

In Figure 5, the duct 50 is comprised of a flange 54 tightly attached to the rear plate 12 (Figure 3) imposing a plate like heat-resistant material and a guiding channel 55 creating the space between the rear plate 12. The guiding channel 55 has such a shape that the air is drawn by the circulating fan 61 and the intaken air is directed upward and is blown through the outlet 122 (Figure 3). That is, the guiding channel 55 is comprised of an intake guide portion 55a having a larger diameter than that of the circulating fan 61 for housing the fan 61, a widening portion 55b steadily extending from the intake guide portion 55a and a blow-out guide portion 55c formed above the widening portion 55b. The intake guide portion 55a is shaped as a semi-circle having a narrow gap between the rim of the circulating fan 61. The width of widening portion 55b is steadily extended with directing the blow-out portion 55c. The longitudinal length of the blow-out portion 55 is approximately the same as that the outlet 122. The intaken air according to the rotation of the fan 61 is diffused along the up-=stream, and is discharged through the outlet 122 (Figure 3), diffusing the heat generated from the heater 101 and evenly transmitting the heat to foodstuff so as to cook thoroughly.

Figures 6 and 7 illustrate modifying embodiments of an inlet and an outlet utilized as an intercommunicating means between the cooking chamber and the duct. Figure 6 shows an inlet 121' extended radially. Figure 7 shows the inlet like in Figure 6 except an outlet 122' formed as a larger single opening.

Figure 8 depicts other embodiment of a guiding channel 55' formed at a duct 50. The guiding channel 55' is comprised of an intake guide portion 55'a having a larger diameter than that of the circulating fan 61 for housing the fan 61, an accelerating portion 55'b having a smaller width than the diameter of the fan and a blow-out guide portion 55'c formed above the widening portion 55'b. The above configurated guiding channel 55' has such an advantage that the air passes through the narrow portion 55'b and increases acceleration and thus cooking time decreases.

The microwave oven employing the above configuration is operated as follows :

Firstly, when in the microwave cooking mode, a start button is pressed and the outside air is drawn into the cooking chamber 100 by the operation of the cooling fan 206 so as to get rid of humidity in the cooking chamber 100. When the fan is rotated, the outside air is drawn into the electrical components chamber 200 through the inlet 12e in the direction of the arrow as shown in Figure 1 to cool the magnetron 201 and the high voltage transformer 202. Next, the air is fed into the cooking chamber 100 through the inlet 14a formed at the right plate 14. Finally,t he air accompanying moisture is discharged to the outside through the outlet 13a formed at the left plate 13 and the outlet 12f formed at the left widened plate 12c. Simultaneously, electricity is supplied to the primary winding of the higher voltage transformer 202 and the higher voltage of an alternating current, i.e. 2,230 V is generated at the secondary winding to be changed into the direct current by the higher voltage diode 203 and the higher voltage capacitor 204. The direct current is supplied to the magnetron 201 to generate the microwave, thus thoroughly cooking by the supply of the microwaves to foodstuffs.

When in the forced air convection cooking mode, electricity is supplied to the heater 101 so as to generate heat, and the fan 61 is rotated, simultaneously. With the rotation of the fan 61, the air in the cooking chamber 100 is drawn into the duct 50 through the inlet 121 and thus is directed up along the guiding channel 55 and finally is discharged to the cooking chamber 100 through the outlet 122 (Figures 3 and 5). The discharged air convects the heat generated from the heater 101, achieving the cooking of foodstuff. More specifically, the fan 61 rotates and the air in the cooking chamber 100 is drawn into the intake guide portion 55a. The drawn airstream is widened by passing through the widening portion 55b and is directed upward. The rising-airstream passes the blow-out guide portion 55c and is discharged into the cooking chamber through the outlet 122 formed in a horizontal manner. The air passes the heater 101 formed corresponding to the shape of the outlet 122 and receives sufficient heat from the heater 101. After the convective circulation takes place in the cooking chamber 100 as shown in Figure 3, the air is fed back to the inlet 121. Since the inlet 121 is distanced from the outlet 122, the airstream directed toward the inlet 121 has little collision with the airstream discharged from the outlet 122 and is smoothly intaken into the duct 50 through the inlet 121. The intaken air receives the rotational force of the fan 61 and is fed up along the guiding channel 55 and is discharged into the cooking chamber 100 through the outlet 122. The above

circulation takes place continually.

Furthermore, in the case that the guiding channel 55' is configurated as shown in Figure 8, the air drawn into the intake guide portion 55'a is accelerated along the widening portion 55'b. The speedy air is discharged to the cooking chamber 100 through the blow-out guide portion 55'c, causing the advantage of faster cooking. The cooling fan 71 rotates simultaneously so as to cool the motor 63. The convection cooking can be operated alone or can be used with the microwave cooking.

The convection microwave oven of the present invention has the following advantages.

By improving the configuration of the duct and the arrangement of the inlet and outlet, no turbulent airstream can take place and the volume of the convection is increased with the active flow of the hot air, causing the efficiency of the cooking to be increased and enabling through cooking. Further, the faster cooking is possible due to the faster flow of the air.

Even though this microwave oven is provided with a grill cooking function, a forced convection cooking function as well as microwave cooking capabilities, compactness and the simplicity of the oven can be achieved. Since the heater is installed in the cooking chamber, the present invention is simpler than the conventional art having an electrical heater and thin thermal-resistance mounted on the exterior of a cooking chamber.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A convection microwave oven comprising:

a body;

a cooking chamber housed in said body;

a fan rotatably mounted between said body and said cooking chamber for circulating the air in said cooking chamber;

an inlet provided on a wall of said cooking chamber for drawing the air in said cooking chamber into said fan;

an outlet provided on a wall of said cooking chamber for blowing the air via said fan toward a heater arranged in said cooking chamber.

2. The convection microwave oven according to Claim 1, wherein said fan is disposed adjacent to said inlet.

3. The convection microwave oven according to Claim 2, wherein said inlet is disposed on a lower portion of said wall of said cooking chamber and said outlet is disposed on an upper portion of said wall of said cooking chamber.

4. The convection microwave oven according to Claim 2, wherein said inlet is disposed on an upper portion of said wall of said cooking chamber and said outlet is disposed on a lower portion of said wall of said cooking chamber.

5. The convection microwave oven according to Claim 3 or 4, wherein a duct is further comprised, said fan is housed in said duct and one of said duct is directed to said inlet and another thereof is directed to said outlet.

6. The convection microwave oven according to Claim 5, wherein said duct has a steadily enlarging portion toward said outlet from said inlet.

7. The convection microwave oven according to Claim 5, wherein said duct has a reducing portion for decreasing volume of the air via said inlet and for conducting it toward said outlet.

EP 0 747 638 A1

FIG. 1

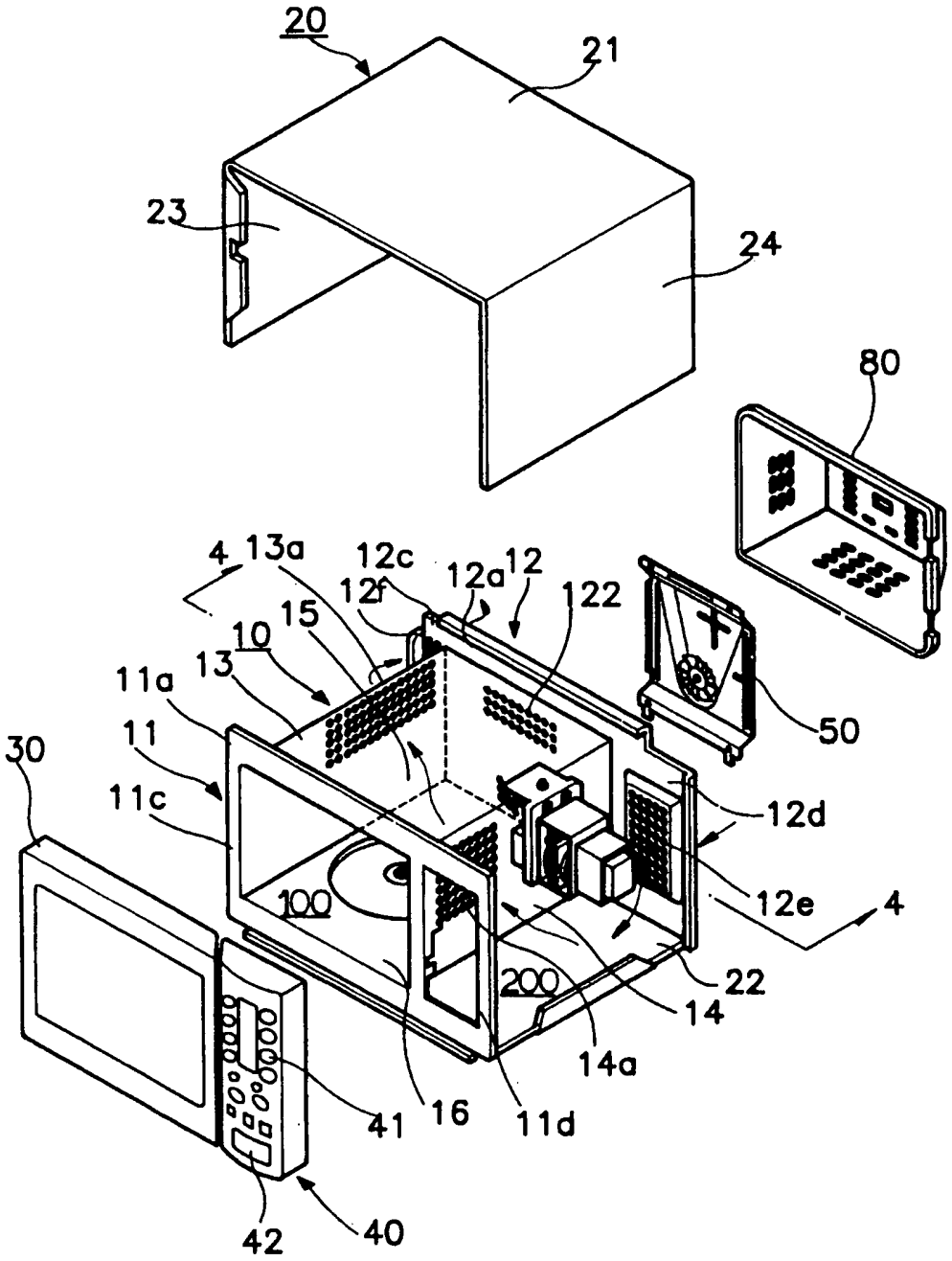


FIG.2

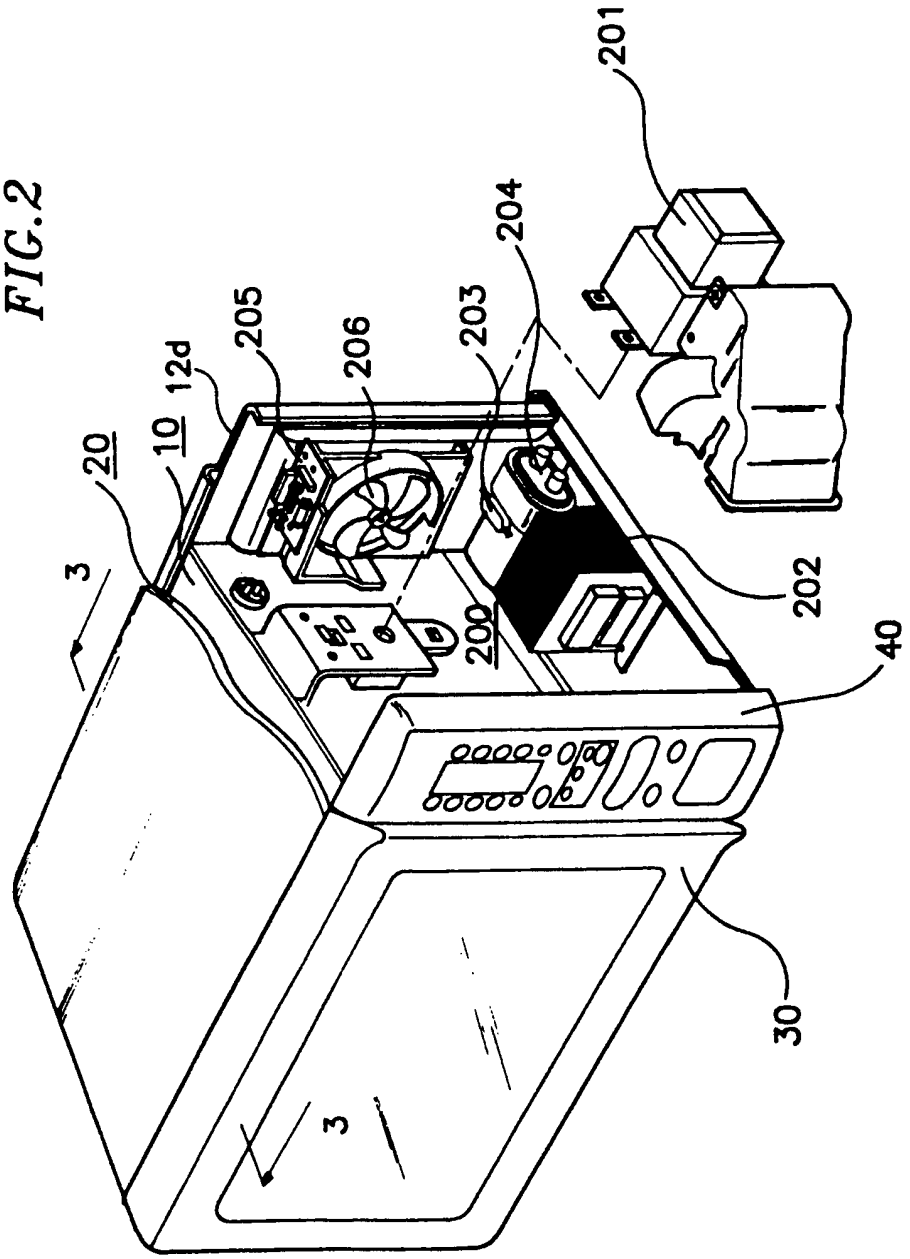
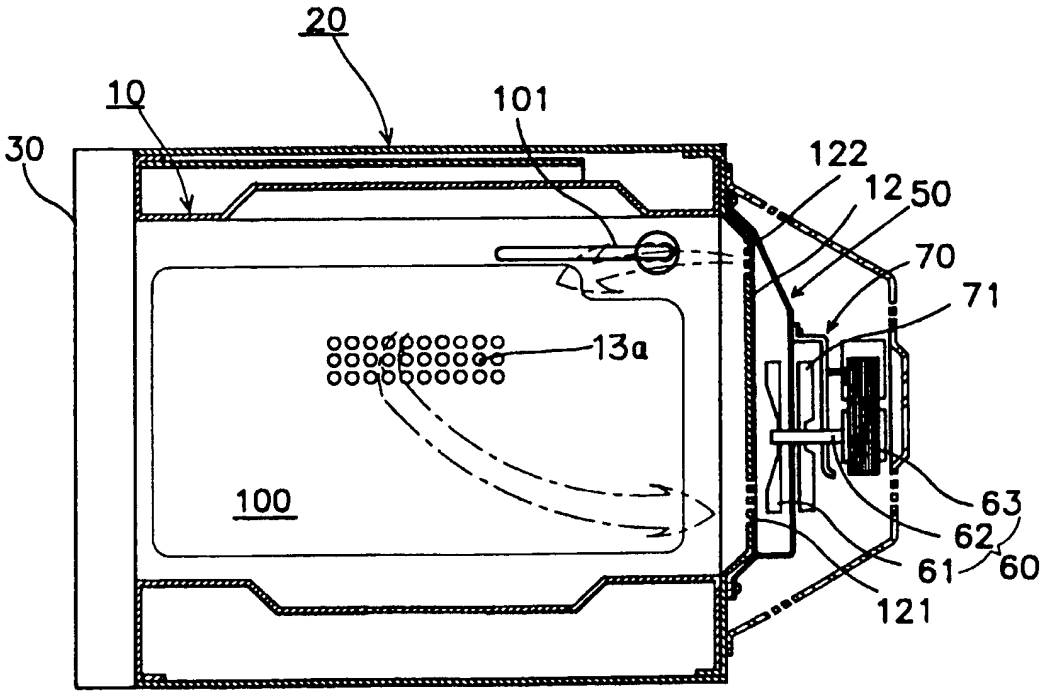
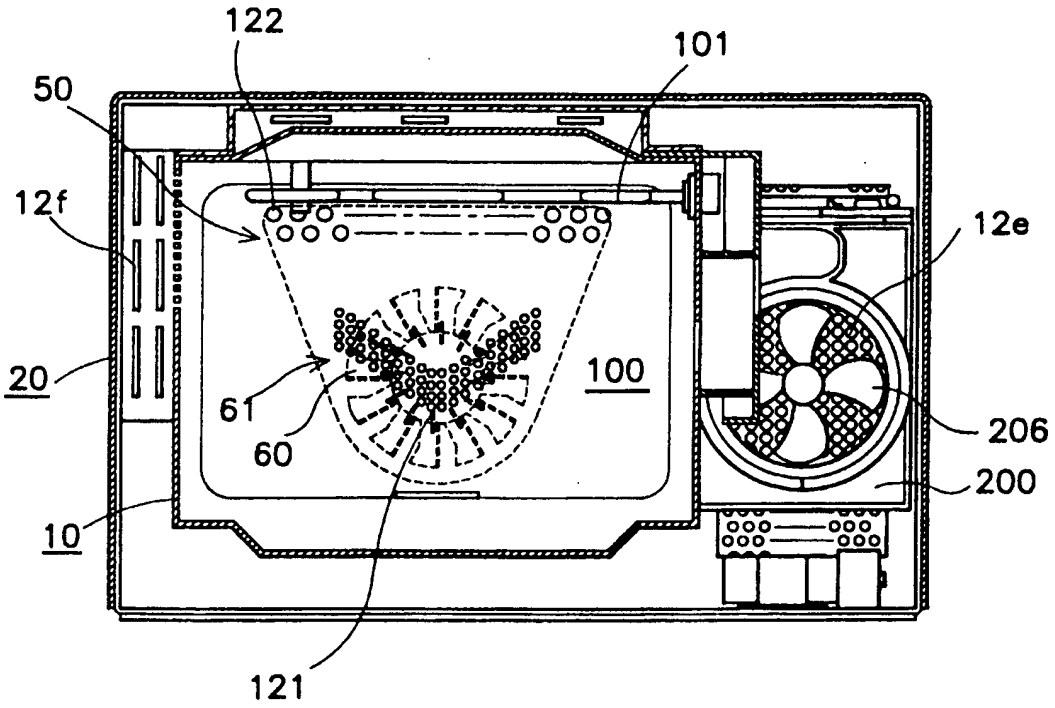


FIG.3



EP 0 747 638 A1

FIG.4



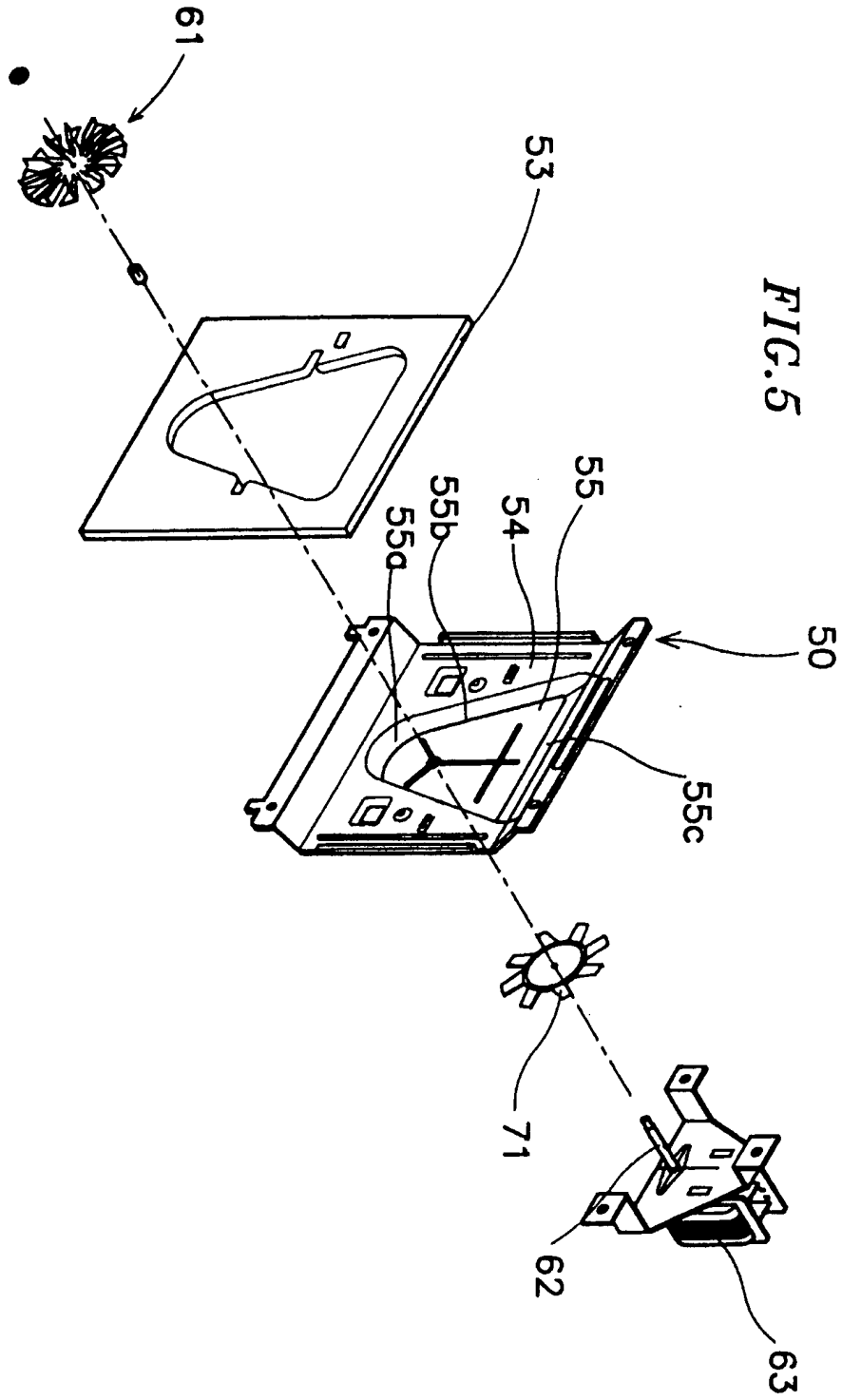


FIG.5

EP 0 747 638 A1

FIG. 6

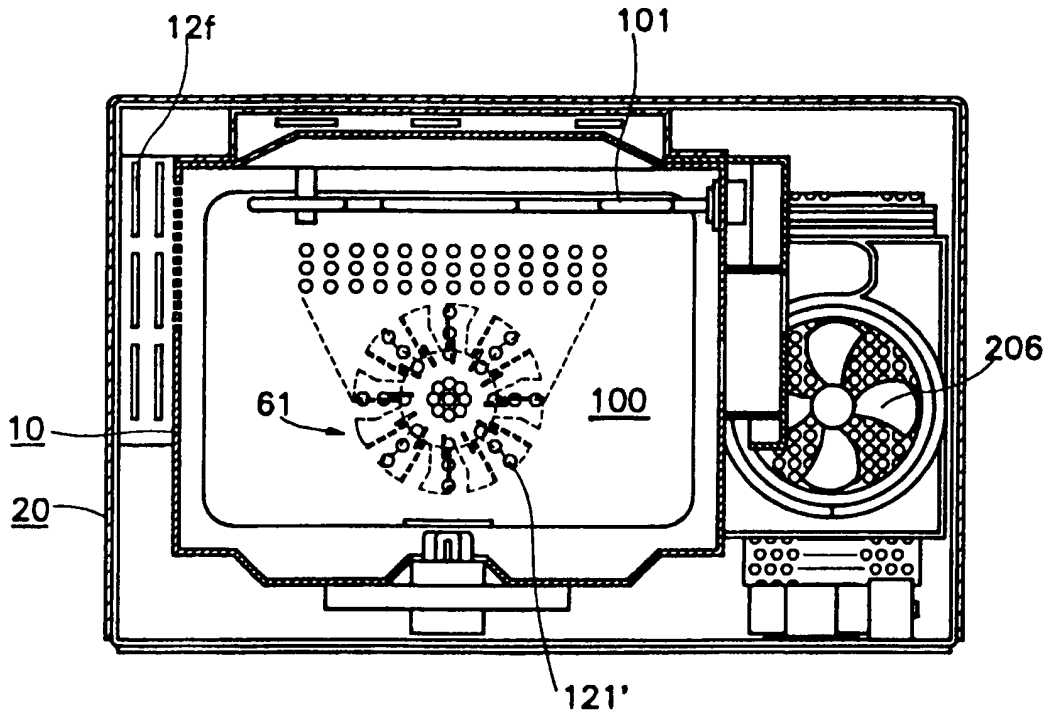
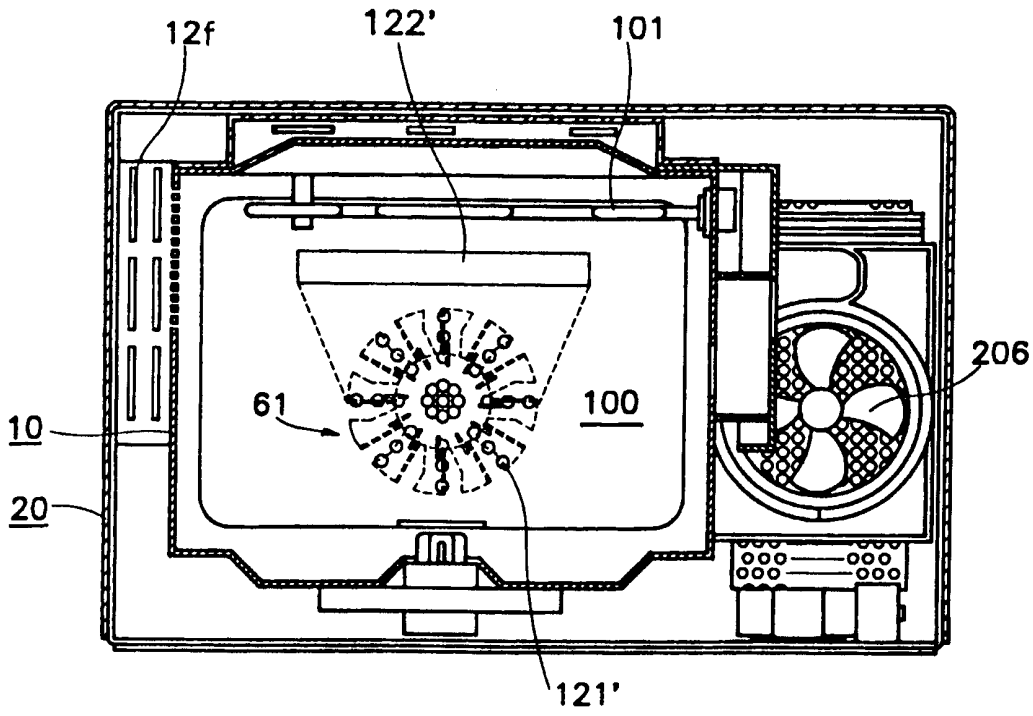


FIG. 7



EP 0 747 638 A1

FIG.8

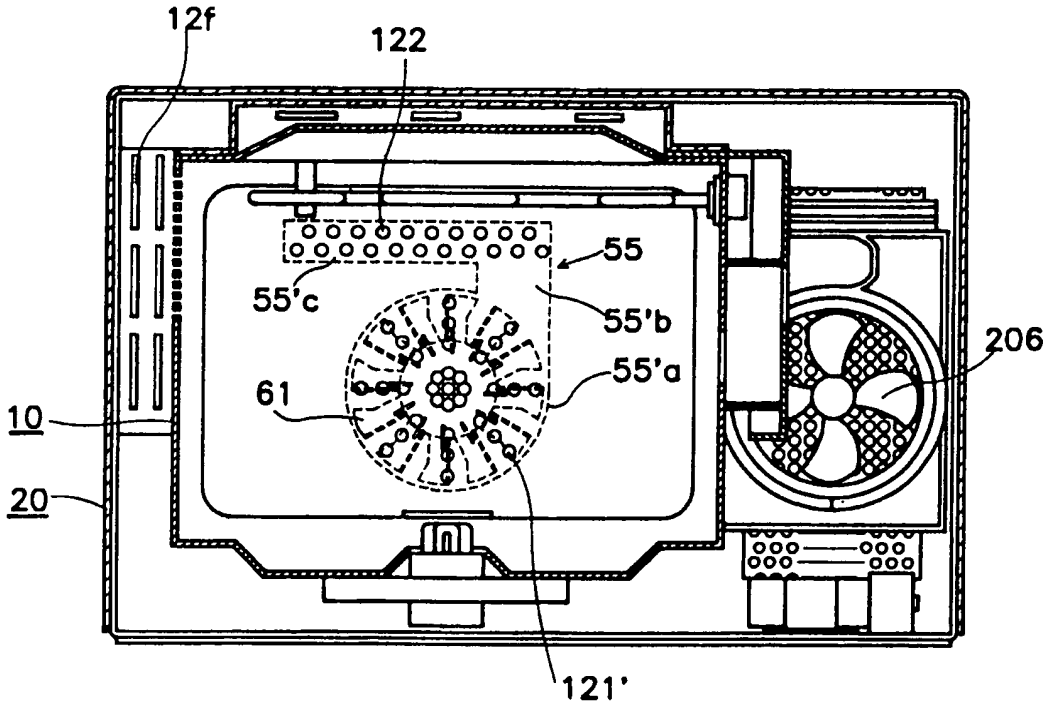


FIG.9
(Prior Art)

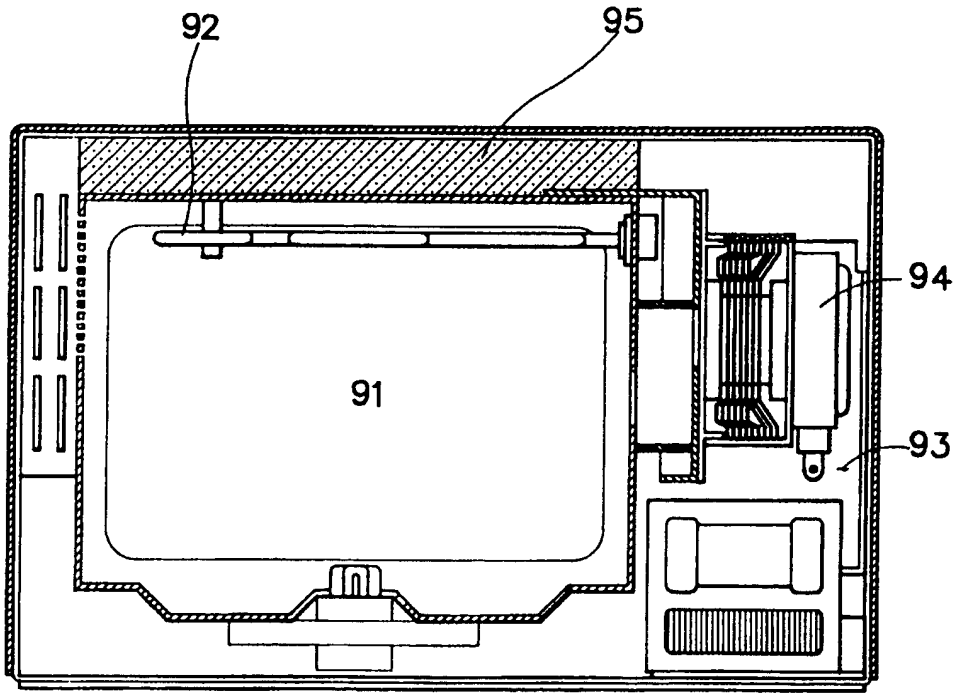
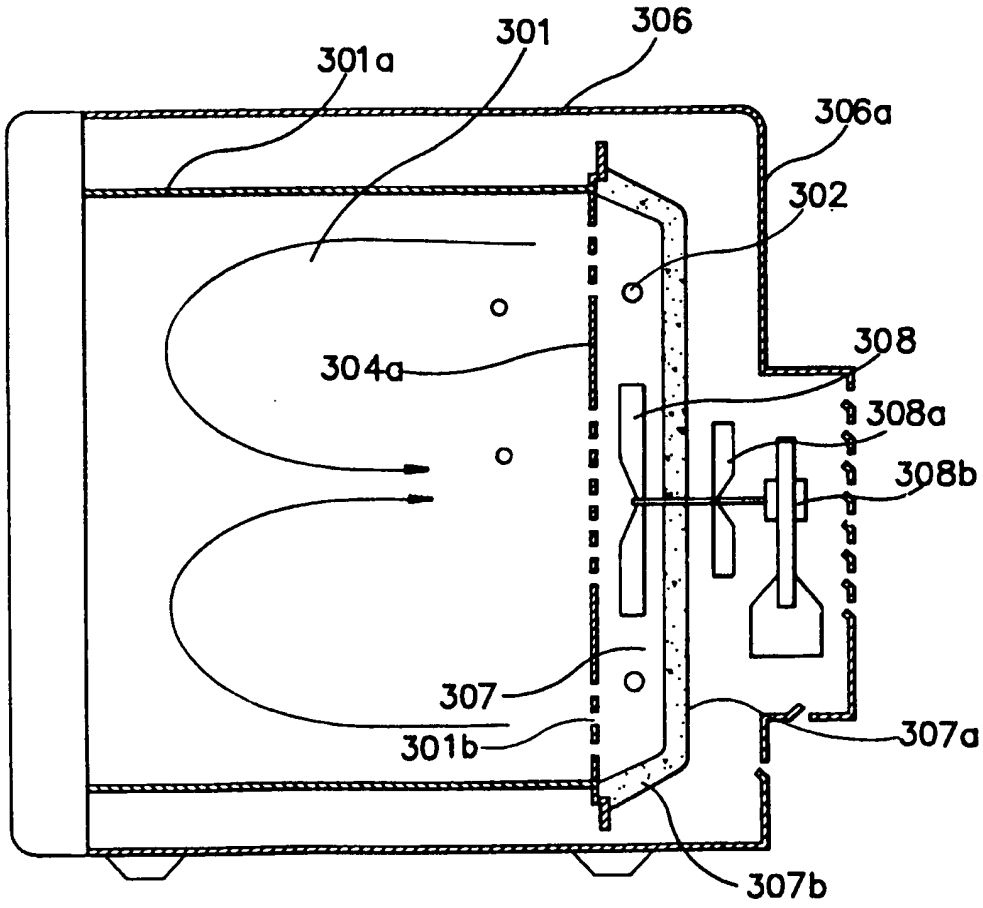


FIG. 10
(Prior Art)



EP 0 747 638 A1

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 10 7963

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US-A-4 332 992 (LARSEN ET AL.) * column 3, line 64 - column 4, line 33; figures 1,3,5 *	1-5	F24C7/02 F24C15/32
A	* figures 1,3,5 *	6,7	
X	US-A-4 940 869 (SCHOLTES ET AL.) * column 4, line 13 - column 5, line 26; figures 1,2,5A-5D *	1,2	
A	* figure 2 *	5	
X	US-A-4 481 396 (MATSUBAYASHI ET AL.) * column 2, line 16 - column 3, line 18; figures 1,2 *	1,2	
X	US-A-4 480 164 (DILLS) * column 2, line 19 - column 4, line 59 *	1-3	
A	US-A-4 780 596 (MATSUSHIMA ET AL.) *Abstract*	5	
A	US-A-5 204 503 (MAIELLANO, JR. ET AL.)		TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	EP-A-0 121 892 (INDUSTRIE ZANUSSI S.P.A.)		F24C H05B
A	WO-A-90 08449 (FRECH)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	29 August 1996	Filtri, G

EPO FORM 1503 03.82 (P04C01)

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document